ΔΕΣΜΟΙ
ΑΝΑΠΤΥΞΗΣ

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A case study of the energy refurbishment of a public building: Assessment of the current situation and evaluation of retrofit solutions

A. Michael[1], A. Kyriakidis[1], A. Michopoulos[1], E. Kyritsi[1], D. Stimoniaris[2], D. Tsiamitros[2], T. Kottas[2]
[1]Department of Architecture, University of Cyprus
[2]Department of Electrical and Computer Engineering, University of Western Macedonia
Contact details of corresponding author
e-mail: kyriakidis.andreas@ucy.ac.cy

Brief Description

- **Programme**: 2014-2020 Interreg V-A Greece-Cyprus
- **Project**: Autonomous intelligent buildings of zero energy consumption connected with sustainable transport systems
- **Project Budget**: 1,909,640 €
- **Financing**: The project is co-funded by the European Union (ERDF) and national funds of Greece and Cyprus
- **Priority axis:** 2.Efficient use of energy and sustainable transport
- **Contribution to the Programme's specific objective**:
  2.1 Increase energy efficiency in public buildings

Consortium

Department of Public Works

Department of Electrical and Mechanical Services

University of Cyprus

General Secretariat Ministry of Environment and Energy

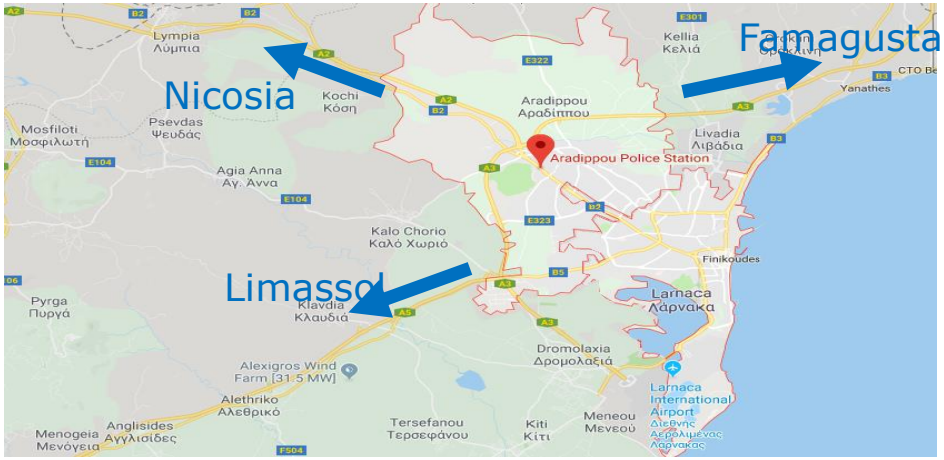
Municipality of Chios

University of Aegean

Case study-Surrounding area

Strategic Position

- Crossroad of four major districts
- Near the International Airport
- Near the Aradippou Lyceum and Town Hall.
- Ideal location for a demonstration pilot project
- Ideal location for charging station

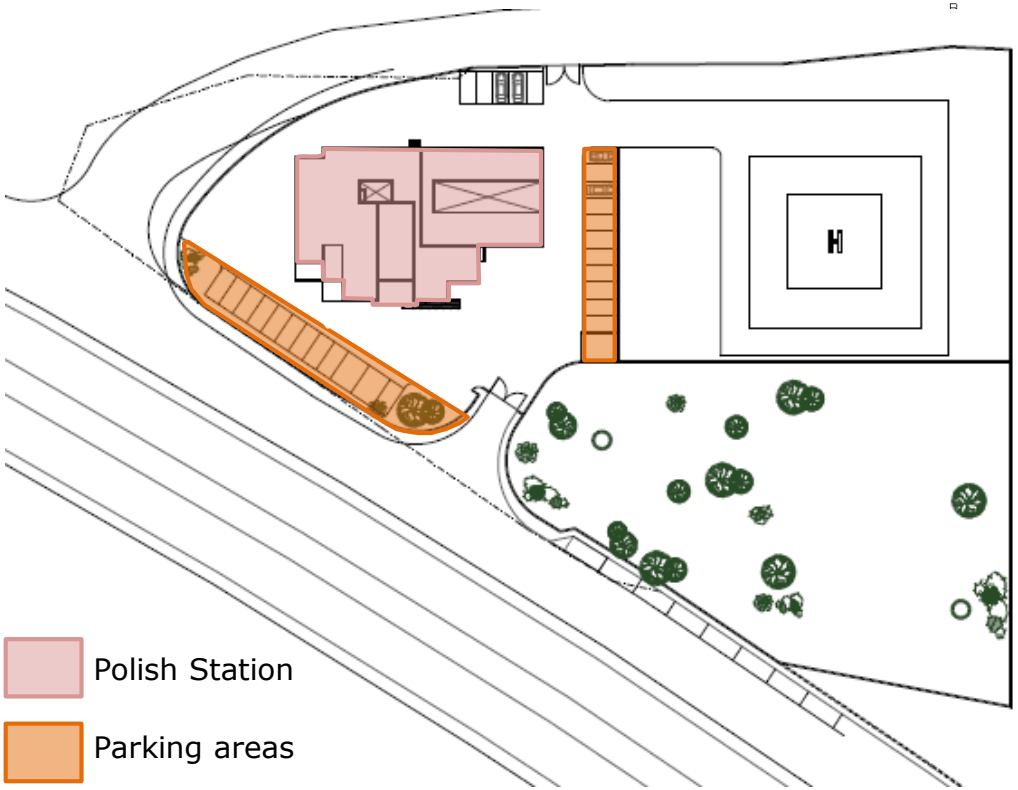


Case Study-Climatic Conditions

- The meteorological data for Larnaca are recorded at the Larnaca International Airport, which is located about 10 km from the case study building.
- Mean temperatures during July and August: 27.6℃
- Mean maximum temperature during July and August: 32.7℃
- Mean temperatures during January and February : 11.8℃
- Mean minimum temperature during January and February : 6.9℃
- Diurnal temperature ranges between 9 and 12℃ during the summer period and between 8 and 10℃ during the winter period.

Case Study-Plot

- Low-density urban fabric
- High traffic road at the North-east side of the plot
- Lyceum is located at the southern side.
- No high buildings around the selected plot
- The building is located on the south-eastern side of the plot



Case Study-Building

General Information

- Total indoor area of the building: 610.32 m^2
- Detention cells: 182.58 m^2
- Other uses: 427.74 m^2
- External wall area: 413.65 m^2
- Windows/doors area: 70.89 m^2
- Window-to-wall ratio: 17 %

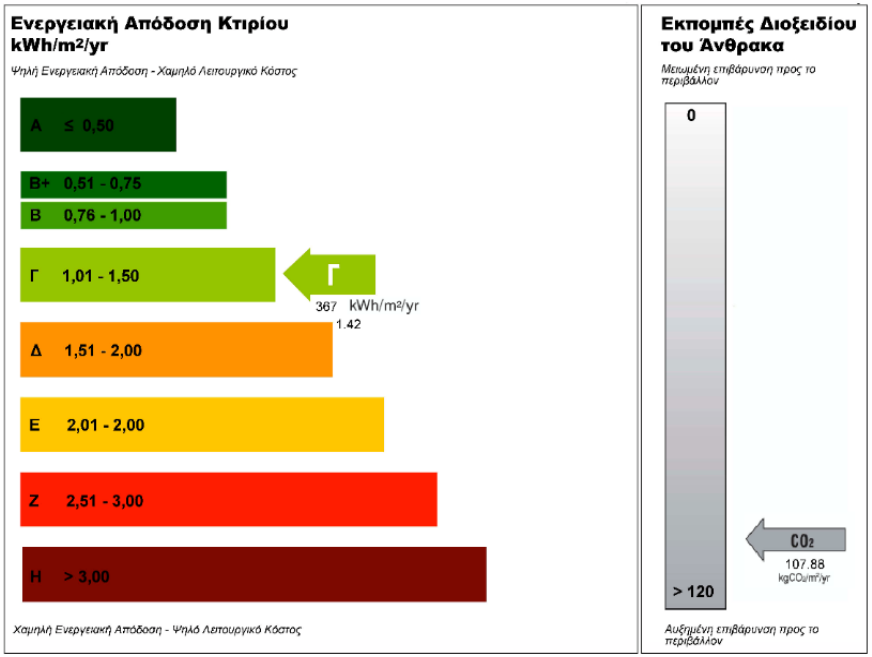
Case Study-Building

- Workplaces
- Circulation area
- Auxiliary spaces
- WC
- Conference room
- Infirmary
- Kitchen
- Detention cells
- Detention cells
- Enclosed Courtyard
- Atrium

Case Study-Building

Energy Performance

- Building Envelope
  - Reinforced concrete components: U-value = 3.00 W/m^{2}K
  - Brick walls: U-value = 1.40 W/m^{2}K
  - Roof: U-value = 0.513 W/m^{2}K
  - Double glazed: U-value = 3.7 W/m^{2}K
- Energy class C
- Annual energy consumption: 367 kWh/m^2/yr,
- Annual CO_2:108 kgCO_2/m^2/yr



Case Study-Building

Particularities

- Working at a 24-hour basis
- High demand for artificial lighting
- High demand for heating and cooling
- Security issues regarding the detention cells
- Installation of products of specific requirements

Case Study-Retrofit Solutions

Building Envelope

- External thermal insulation
  - Walls: 10 cm thick rock mineral wool
  - Roof: 10 cm thick polyurethane foam
  - Basement Roof: 10 cm thick rock mineral wool slabs.

- New triple glazed windows
  - 1.3 W/m^{2}K U-value .

Retrofit action	Existing U-value (W/m^{2}K)	Max U-values allowed be national regulation (W/m^{2}K)	U-value after refurbishment (W/m^{2}K)	Thermal insulation Improvement (%)
Insulation of load-bearing components	3.00	0.4	0.31	90.0
Insulation of Brick walls	1.40	0.4	0.28	80.0
Roof Insulation	0.51	0.4	0.31	40.0
Basement roof slab insulation	2.59	0.4	0.30	88.0
Replacement of existing Windows	3.70	2.25	1.30	65.0

Case Study-Retrofit Solutions

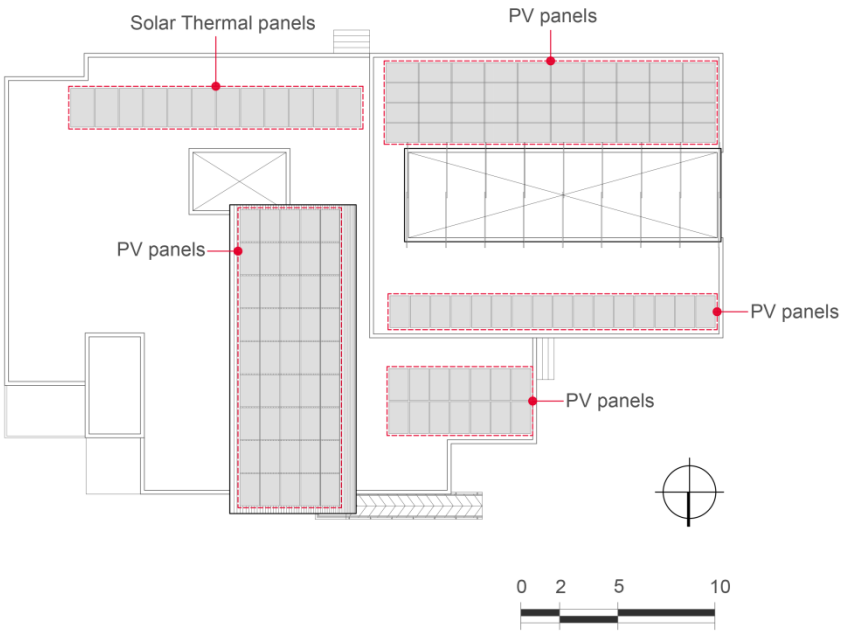
HVAC system / Artificial lighting

- Installation of three new high efficiency VRF for cooling and heating
  - Equipped with KNX interface for complete connectivity and control
- Replacement of existing lighting system with new A+ LED lights
- Vandal-resistance LED lights inside the detention cells
  - High resistance to damage
  - Suitable for areas such as prisons, psychiatric hospitals, gyms and underground pedestrian streets.

Case Study-Retrofit Solutions

Renewable Energy Sources

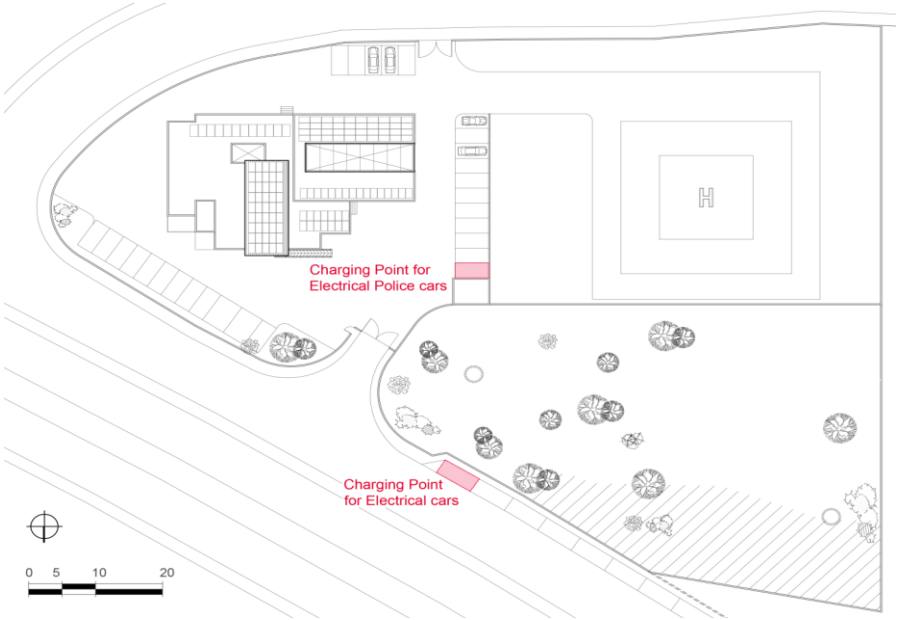
- Solar Thermal System
  - Hot Water and space heating
  - Total area 30 m^2
  - Placed on the south side of the building's roof
- PV system
  - 19.25 kWp for building demand
  - 12 kWp for charging station
- Lithium-ion batteries



Case Study-Retrofit Solutions

Charging Station for electric cars

- Promote Sustainable mobility
- Two charging points
  - One charging point for the police station workers and for the police's electric car
  - One public charging point
- Able to fully charge an electric car



Case Study-Retrofit Solutions

Building "intelligent" monitoring system

- "Intelligent" energy management system
  - surveillance, control and metering of the building energy use
- In-situ measurements for temperature, heat inflow and outflow, heat absorbed by the building structure, surface temperatures etc.
- Regulating the operation of the HVAC units for efficient use
- Application for portable devises for remote control of the system
- The recorded data for the energy efficiency of the building will be exported and displayed on a projection screen in order to increase environmental awareness.

Case Study-Expected outcome

- The energy refurbishment of the case study Public building aims to be the starting point to the creation of Zero Emissions Public Buildings
- Energy demand is expected to be reduced by 68%
- The reduced demand will be covered by renewable energy sources.
- The “intelligent” monitoring system will manage and optimize the energy use of the building reducing even more the energy demand

Case Study-Expected outcome

- A manual will be issued to disseminate the produced knowledge
- New charging stations for electric cars
- Training seminars for better energy use from the owners
- Educational tours for students will be organized in order to be informed for the good practices and technologies installed in the building and increase their environmental awareness

Conclusions

- Part of the research program ΑΥΤΟΝΟΜΩ "Autonomous intelligent buildings of Zero Energy consumption connected to sustainable transport systems"

- The project is co-funded by the European Union (ERDF) and national funds of Greece and Cyprus through the cooperation programme Interreg VA Greece-Cyprus 2014-2020.

- The program aims to address the challenge of a novel and innovative concept of public buildings, i.e. the creation of Zero Emission Buildings.

Conclusions

- Improvement of the building envelope insulation level to minimize heat gains and losses and reduce energy demand
- Installation of high efficiency equipment for heating, cooling and lighting
- Use of Renewable Energy Sources
- Use of "intelligent" energy management
- The case study building has high potential to be upgraded into a pilot Zero Emission Building
  - Demonstration project for other public buildings of Cyprus and potentially of any other area with similar climatic conditions

Thank you for your attention!

for any further information please contact:
kyriakidis.andreas@ucy.ac.cy